

SHORT TERM PERFORMANCE EVALUATION OF A RURAL
ROAD EMBANKMENT WITH DIFFERENT REINFORCEMENT
CONSTRUCTED ON SOFT SOIL PERTAINING TO
VERTICAL SETTLEMENT

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SETTLEMENT**


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**This dissertation is submitted as a fulfillment of
the requirements for the award of the Degree Of
Master of Civil Engineering**

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Specially dedicated to my beloved mother and father, family and friends. Thanks for all the patience and love. May The Almighty Allah SWT bless you all always.

Acknowledgement

Syukur Alhamdulillah, with the blessing of The Almighty, the Projek Sarjana have been successfully completed. I would like to take this opportunity to thank my project supervisor, Professor Dr. Hj. Ismail Bin Hj. Bakar, co-supervisor, Mr. Adnan Bin Zainorabidin and project advisor, Associate Professor Mohd. Idrus Bin Mohd Maisirin, all the lecturers of FKAAS especially Mr. Nazri Mohideen and Mr. Aziman, and the lab technicians, Mr Amir Zaki Bin Salikin, Mr. Azuan, Mrs. Zamra and Mr. Khairi. Only with their support and guidance I managed to finish this project and my studies in Kolej Universiti Teknologi Tun Hussein Onn.

I would also like to convey my thanks to my beloved parents, Mr Abdurahman Moideen and Mrs Zaleha Mohamad, and my family for their guidance and supports throughout my studies. Only with your support and blessings I have managed to continue my study this far.

I also would like to thank all my friends especially Abdul Mutalib Abd. Rahman, Mohd Apiz, Mustazha Hakim, Mahvidayanti, Mohd Annuar, Tan Boon Seng, Nor Ashikin Marzuki and Wong Charng Cheng for their help and support throughout this research.

Thank You.

ABSTRAK

Pembinaan jalan raya di kawasan tanah lembut merupakaj suatu kebiasaan di selatan Semenanjung Malaysia terutamanya berhampiran kawasan pantai. Pelbagai masalah sering dihadapi semasa pembinaan jalan raya dijalankan di atas tanah lembut. Tanah lembut adalah kurang stabil dan mengalami enapan primer dan enapan jangka masa panjang yang besar apabila dikenakan dengan pertambahan beban. Sebelum turapan dibuat di atas tanah lembut, kebiasaannya tanah tersebut akan diperkuatkan dahulu dengan menggunakan geotekstil. Ujikaji ini dijalankan untuk mendapatkan hubungkait di antara kekerapan beban dinamik menggunakan lori 5 tan dengan enapan bagi jalan yang dibina di atas tanah lembut.

Dalam kajian ini, dua (2) jenis geotekstil telah digunakan. Ianya adalah *Rawell Geosynthetic Clay Liner(RGCL)* dan *Woven Geotextile(WG)*. Ujian dan pemerhatian yang berterusan dijalankan ke atas 3 model jalan skala penuh yang dibina di atas tanah lembut di Pusat Kajian Tanah Lembut(RECESS), KUiTTHO. Beban dengan menggunakan lori 5 tan dikenakan ke atas setiap bahagian jalan semasa proses pembebanan dinamik dan statik dijalankan. Daripada analisa yang dijalankan terhadap keputusan kajian, didapati bahawa semasa beban dinamik 50 pusingan sehari dikenakan ke atas jalan, nilai enapan bagi RGCL ialah 0.030 m dan 0.063 m, dan bagi WG pula ialah 0.168 m dan 0.082 m masing-masing bagi bahagian yang dikorek 0m dan 0.5 m. Semasa beban dinamik sebanyak 100 pusingan sehari pula, nilai enapan bagi RGCL ialah 0.026 m dan 0.068 m, dan bagi WG pula ialah 0.168 m dan 0.088 m masing-masing bagi bahagian yang dikorek 0 m dan 0.5 m. Daripada data di atas, kita dapat melihat bahawa keberkesanan penggunaan RGCL adalah lebih baik jika dibandingkan dengan WG. Malah, dengan penambahan beban dinamik, nilai enapan juga turut bertambah.

ABSTRACT

Construction of roads on soft soil is common in Southern part of Peninsular Malaysia especially on its coastal area. Many problems were faced during road constructions when done on soft soils. They are subjected to instability and massive primary and long term consolidation settlements when subjected to even moderate load increases. Most pavements constructed in such a difficult grounds are improved with the use of geotextiles. This research is carried out to get a correlation between the frequency of standard truck loading with the settlement for road embankment constructed on soft soil using different reinforcements.

Two (2) types of geotextiles are used. They are Rawell Geosynthetic Clay Liner(RGCL) and Woven Geotextiles(WG). Continuous monitoring and evaluation are conducted on three (3) different full-scale road embankment models at Research Centre for Soft Soil (RECESS). All sections are loaded using 5 ton truck during Static and Dynamic loading. The performance of road in every sections are monitored and evaluated. From findings, it shows that for frequency of 50 passes per day the settlements for GCL are 0.030 m and 0.063 m, and for WG are 0.168 m and 0.082 m for both 0 m and 0.5 m excavated sections respectively. For frequency of 100 passes per day the settlements for GCL are 0.026 m and 0.068 m, and for WG are 0.168 m and 0.088 m for both 0 m and 0.5 m excavated sections respectively. From the data, we can see that the performance of GCL is better compared to WG for the 0 m and 0.5 m excavated sections. The values of settlement in every sections are also increased when the frequency of dynamic load is increased.

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LIST OF SYMBOLS

GCL	Geosynthetic Clay Liner
RGCL	Rawell Geosynthetic Clay Liner
WG	Woven Geotextile
1 A	0 m Excavated Section Reinforced with RGCL
2 A	0 m Excavated Section Reinforced with WG
3 A	0 m Excavated Control Section
1 B	0.5 m Excavated Section Reinforced with RGCL
2 B	0.5 m Excavated Section Reinforced with WG
3 B	0.5 m Excavated Control Section
kPa	Kilo Pascal

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CHAPTER I

INTRODUCTION

1.1 Research Background

Malaysia is a developing country. As a result of the rapid development of the country coupled with a strong economic performance over the past years, there has been a considerable amount of development in all major city areas. As a result, there is an increasing scarcity of suitable land for developments.

Character of Malaysian soil differs from the north to the south and from the east to the west of Malaysia. Some parts are of granites and some of clays. But, most of the southern Malaysian soil consists of soft clayey soils, peaty soils and some sandy-clay soils. The latter types of soils are not conducive to road construction thus, if the techniques of road design and construction is not in accordance with the soil conditions, then failure will prevail before its design life. The south of Malaysia region has a high water table that will directly affect the performance and design life of the road pavement. (Masirin, 2002)

Most pavements constructed in such difficult grounds are improved with the use of geotextiles. The most popular geotextiles used in Malaysia are the HDP and Polyfelt, which act as an agent to hold the pavement together and function as a slab. Meanwhile it is also used to ensure zero subsurface water seepage into the road pavement, which will affect the performance and design life of the pavement. Thus, in this project, a new type of geosynthetic is introduced as an agent to enhance performance and design life of the road pavement especially when constructed on difficult ground conditions. The new geosynthetic is known as pre-hydrated geosynthetic clay liner (RAWMAT), which is produced by Rawell Environmental Ltd, United Kingdom.

1.2 Problem Statement

Soft soils can create over-drainage and will in turn cause a chain of problems such as increase in rate of subsidence, occurrence of flooding, increase in the occurrence of acid-sulphate soils, forest fire, pest infestation and termite attack, nutrient imbalance to crop and greenhouse effect. Most of the settlements on soft soils are due to subsoil consolidation when excessive pore pressure induced by embankments dissipates with time and creeping effect. The south of Malaysia region has a high water table that will directly affect the performance and design life of the road pavement.

1.3 Research Objective

This research topic is aimed to achieve the followings:

1. To determine and analyze the vertical settlement characteristics of trial road embankments constructed on soft soil conditions.
2. To observe and monitor the performance of a rural road embankment constructed at Research Centre for Soft Soil (RECESS) Malaysia as a case study and obtain a correlation between frequency of standard truck loading passes with vertical settlement under a road embankment constructed on soft soil with different reinforcements.

1.4 Scope of Study

The necessity to study the behaviour of road embankments especially pertaining to its vertical settlement characteristics may lead to the ability to monitor and reduce severe road pavement failures. With the availability of quantitative data correlating frequency of truck loading passes with earth pressures and settlements, engineers will be able to determine the actual functional life of the road pavement.

In order to achieve correlation between frequency truck loading passes with earth pressure and vertical settlement under a road embankment constructed on soft soil project headed by Associate Professor Mohd Idrus Mohd Masirin and Mr. Adnan Zainorabidin at RECESS Malaysia in KolejUniversiti Teknologi Tun

Hussein Onn and collected the relevant data via the state of the art computer-based equipment monitoring system. These data are obtained from actual field experiments and with permission from RECESS Malaysia.

CHAPTER II

LITERATURE REVIEW

2.1 Introduction

Malaysia is categorized as a tropical country and is situated near the equator between latitudes 1°20'N to 6°40'N and longitudes 99°35'E to 104°20'E has an area of 131,794 square kilometers. Its climate is warm and humid all year round and enjoys an equatorial climate with temperatures ranging from 22°–32°C in the lowlands. Highland areas experience cooler weather. It has a high annual rainfall intensity averaging 200 cm –250 cm. With a diverse difference of temperature and heavy rainfall intensity, infrastructure construction may experience a lot of challenges in especially construction of roads on difficult ground condition. Malaysia consists of 15 states, which include a Federal Territory, were spread-out and built among plains, hills, and mountains. An environmental impact assessment is conducted during the planning of a road. Project planning and construction must also consider the rainy season and its location. Malaysian soil is geologically diverse; from gravelly granite rocks to peaty soft soil. The soils of Peninsular Malaysia is termed as 'Tropical Soils', as, they are produced principally by the process of tropical weathering (Hussein, AN; 1995).

Geographically, most Malaysian low lands were covered with swampy, limestone, peat or soft soils. This is due to the existence of rivers and heavy rain in